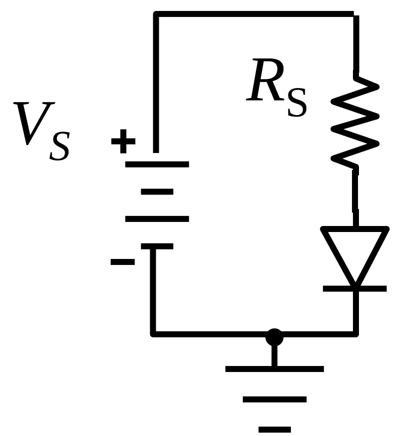
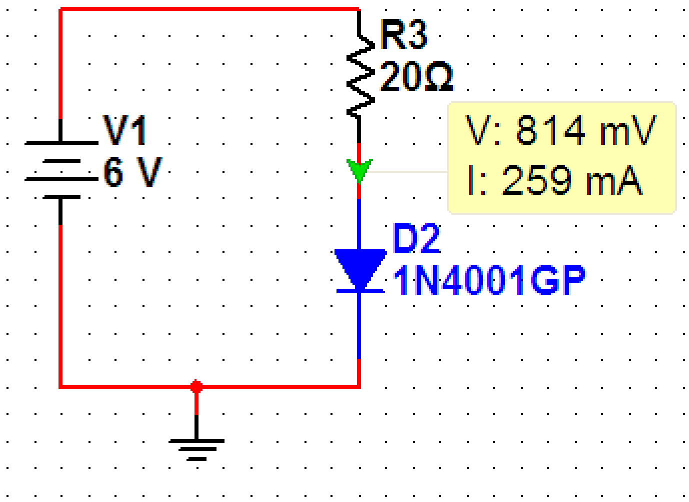
Exercise 1



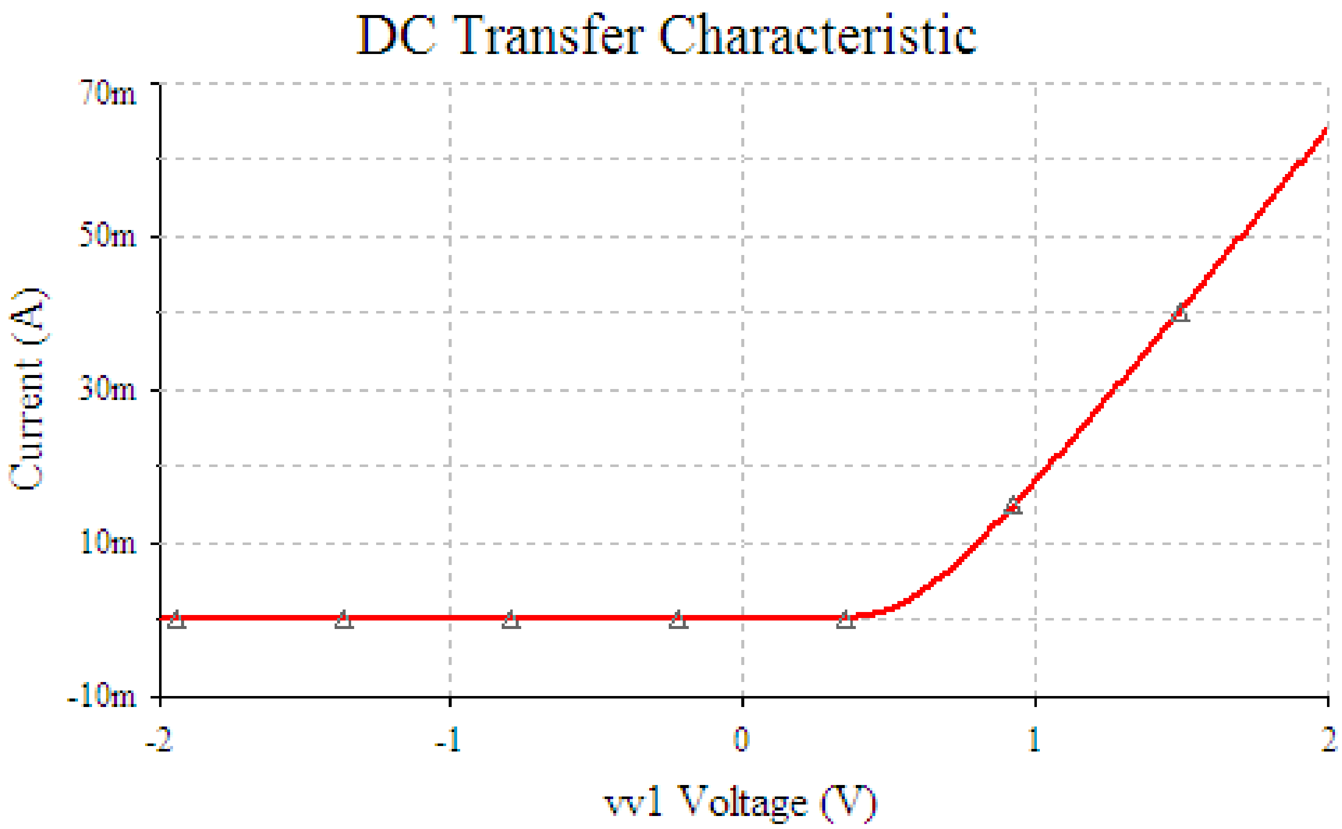
Find the current through the diode if V_S = 6 V and R_S = 20 Ω.

Exercise 1 - Solution

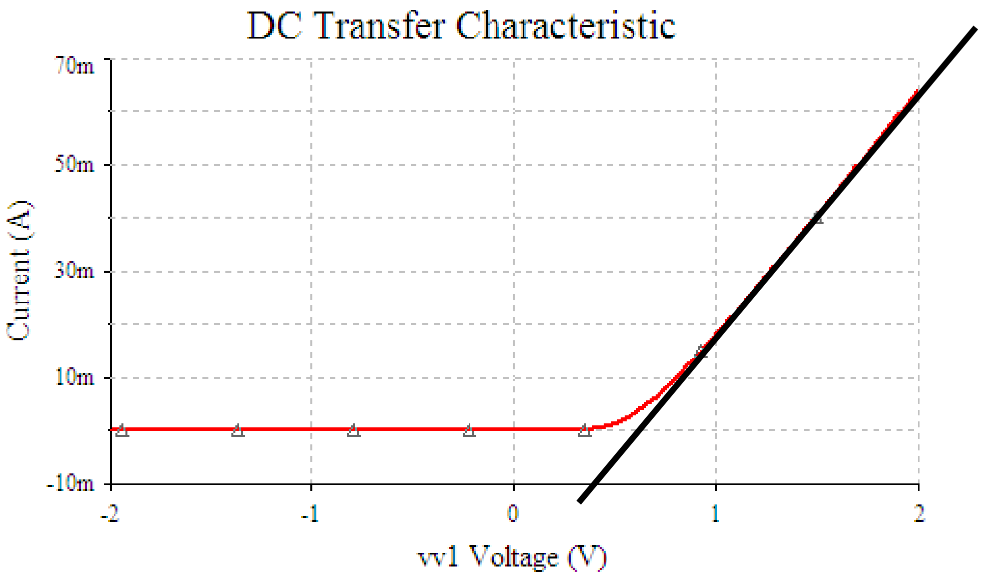


$$i = \frac{V_1 - 0.7}{R_3} = \frac{5.3}{20} = 265\,\text{mA}$$

Exercise 1 – DC Sweep



Exercise 1 - Analysis



From Excel:

Slope $g = 0.04544$

$R_{\text{eff}} = 1/g = 22\ \Omega$

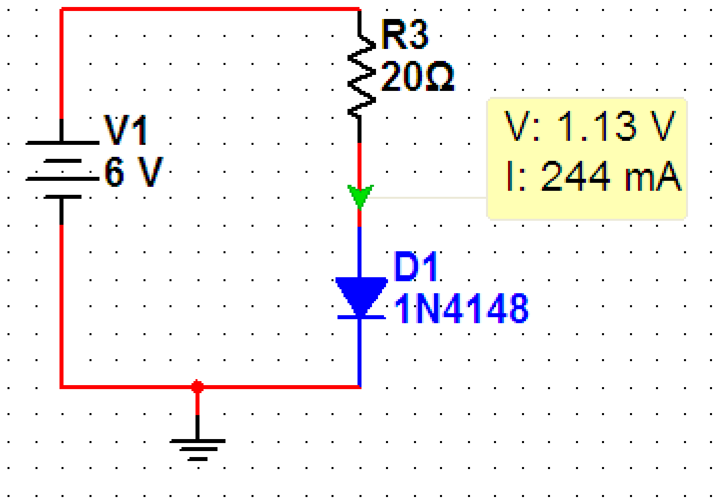
$R_{\text{diode}} = 22 - 20 = 2\ \Omega$

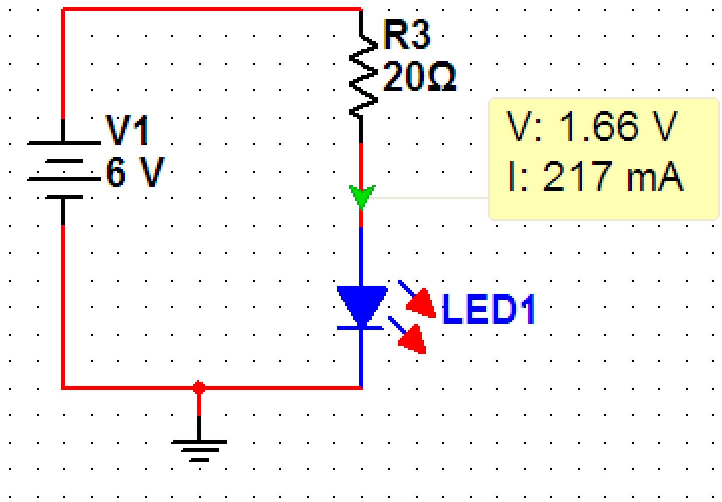
x-intercept = 0.60 V

Note: if analysis is extended to 6 V, R_{eff} is 20.7 and x-intercept = 0.62 V.

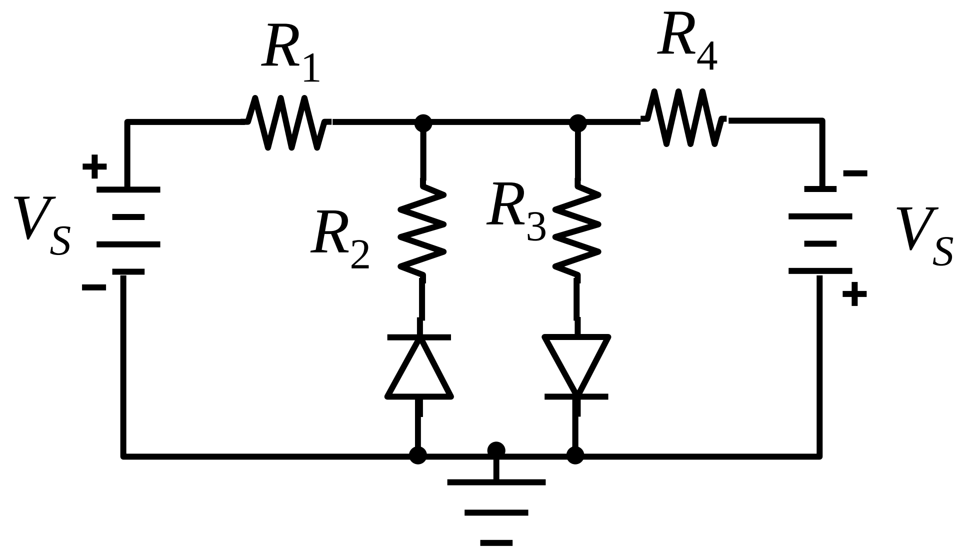
$$i = \frac{V_1 - 0.62}{R_{eff}} = \frac{5.38}{20.7} = 260\,\text{mA}$$

Other Diodes





Exercise 2

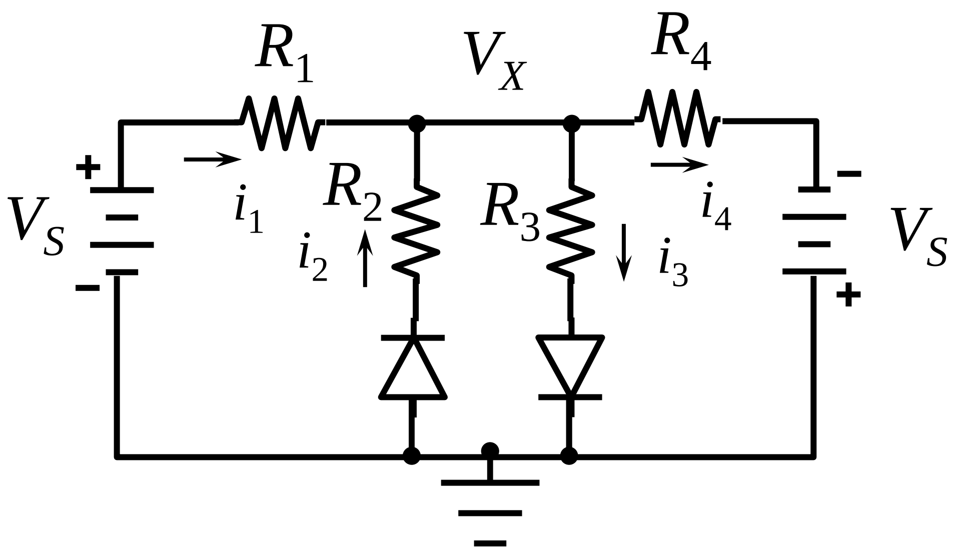


Let $R_1 = R_3 = 20\ \Omega$ and $R_2 = R_4 = 10\ \Omega$

Let $V_S = 3$ V

Find the current through the conducting diode(s)

Exercise 2 – (Neither?)



Neither diode conducts?

$$i_1 = i_4$$

$$\frac{V_S - V_X}{R_1} = \frac{V_X + V_S}{R_4}$$

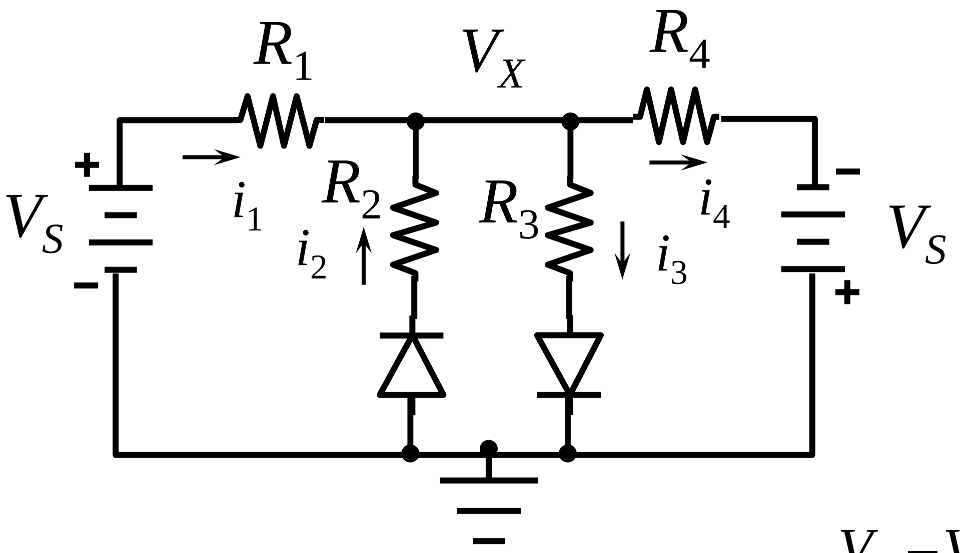
$$R_4 V_S - R_4 V_X = R_1 V_X + R_1 V_S$$

$$V_X = \frac{R_4 - R_1}{R_4 + R_1} V_S$$

$$V_X = -\frac{10}{30} \cdot 3 = -1$$

This implies first diode conducts and second one does not.
See slide.

Exercise 2 Solution- both (1/2)



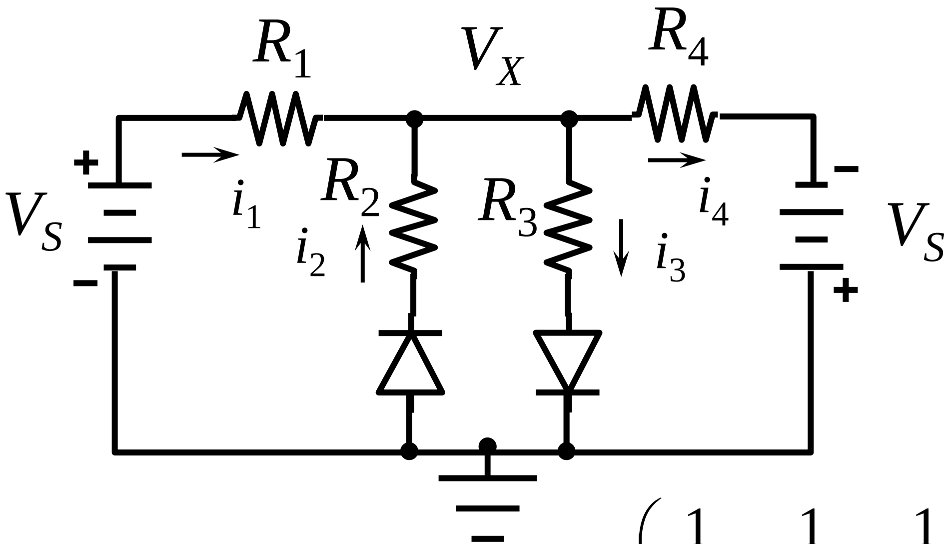
Both conduct?

$$i_1 + i_2 = i_3 + i_4$$

$$\frac{V_S - V_X}{R_1} + \frac{-0.7 - V_X}{R_2} = \frac{V_X - 0.7}{R_3} + \frac{V_X + V_S}{R_4}$$

$$V_X\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right) = V_S\left(\frac{1}{R_1} - \frac{1}{R_4}\right) + 0.7\left(\frac{1}{R_3} - \frac{1}{R_2}\right)$$

Exercise 2 Solution – both (2/2)



Both conduct?

$$i_1 + i_2 = i_3 + i_4$$

$$V_X\left(\frac{1}{20}+\frac{1}{10}+\frac{1}{20}+\frac{1}{10}\right)=V_S\left(\frac{1}{20}-\frac{1}{10}\right)+0.7\left(\frac{1}{20}-\frac{1}{10}\right)$$

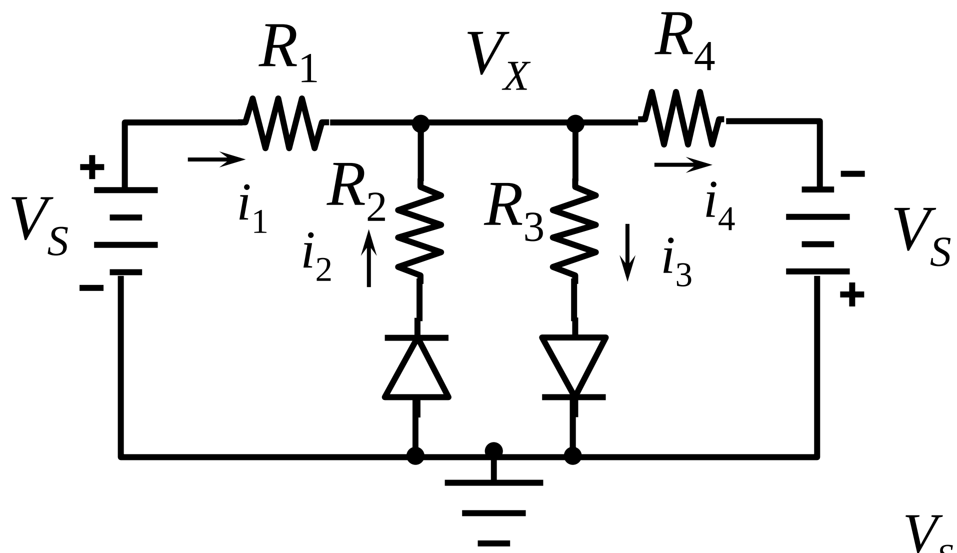
$$i_2 = -\frac{0.7+V_X}{R_2}$$

$$V_X = -\frac{0.7+V_S}{4} = -\frac{3.7}{4} = -0.91$$

$$i_3 = \frac{V_X - 0.7}{R_3}$$

$i_2 > 0$ and $i_3 < 0$ so second diode does not conduct.

Exercise 2 Solution (first)



First diode conducts?

$$i_1 + i_2 = i_4$$

$$\frac{V_S - V_X}{R_1} + \frac{-0.7 - V_X}{R_2} = \frac{V_X + V_S}{R_4}$$

$$\frac{V_S - V_X}{20} + \frac{-0.7 - V_X}{10} = \frac{V_X + V_S}{10}$$

$$V_S - V_X - 1.4 - 2V_X = 2V_X + 2V_S$$

$$5V_X = -V_S - 1.4$$

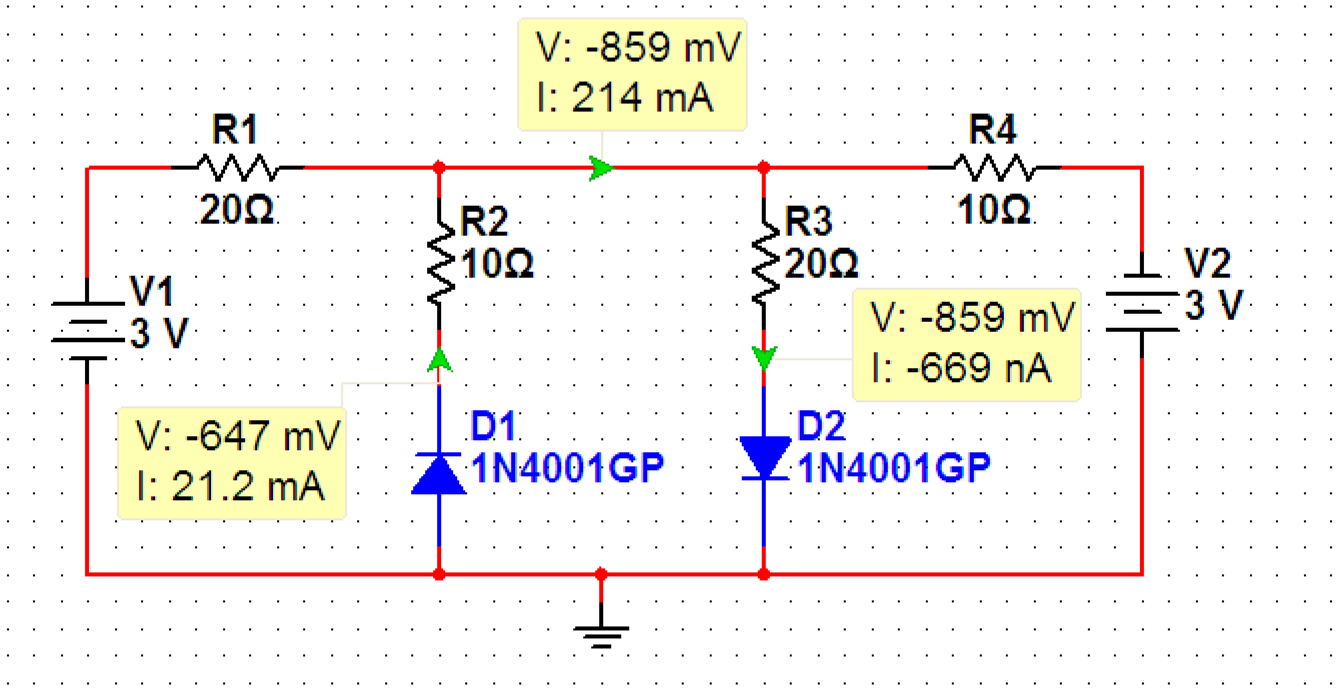
$$V_X = -\frac{4.4}{5} = -0.88$$

$$i_2 = -\frac{0.7 + V_X}{R_2}$$

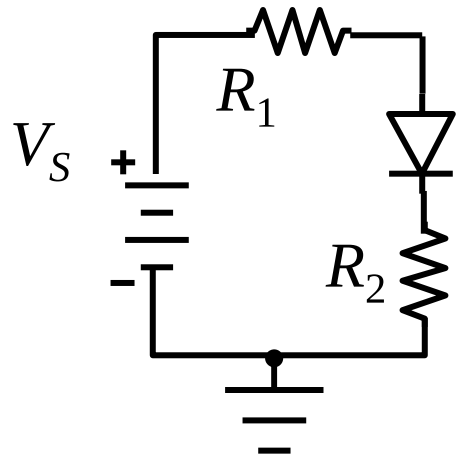
$$i_2 = -\frac{-0.18}{10} = 18\,\text{mA}$$

$$i_3 = \frac{V_X - 0.7}{R_3}$$ (still does not conduct)

Exercise 2 Multisim



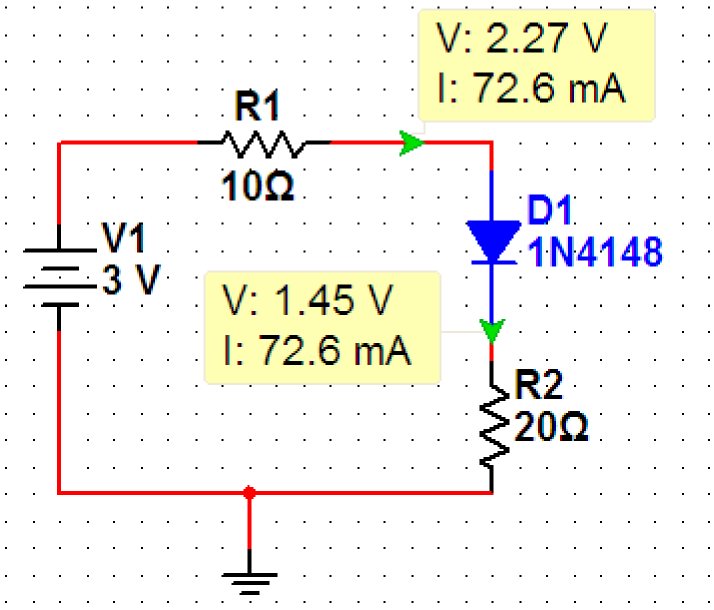
Exercise 3



V_S = 3 V,
R_1 = 10 Ω
R_2 = 20 Ω.

Find the current through the diode and the voltage on either side of the diode.

Exercise 3 Solution



KVL $$V_S = i_D R_1 + 0.7 + i_D R_2$$

$$i_D = \frac{V_S - 0.7}{R_1 + R_2}$$

$$i_D = \frac{3 - 0.7}{30} = \frac{2.3}{30} = 76.7 \text{ mA}$$

$$V_1 = 3 - 10 \cdot i_D = 2.23 \text{ V}$$

$$V_2 = 20 \cdot i_D = 1.53 \text{ V}$$